SURVEY FOR CONTAMINANTS IN SEDIMENTS IN PIGEON CREEK AT CRAB ORCHARD NATIONAL WILDLIFE REFUGE MARION, ILLINOIS

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Introduction

A survey for environmental contaminants was conducted by U.S. Fish and Wildlife Service personnel in 1986 which included several locations on Crab Orchard National Wildlife Refuge (CONWR). During this survey, small concentrations of polychlorinated biphenyls (PCBs) were detected in Pigeon Creek, a small stream located along the northern edge of Crab Orchard Lake. A follow-up survey was initiated in 1988 to make a further determination of specific areas of potential PCB contamination in Pigeon Creek.

Study Area Description

The study area was approximately a 1½ mile stretch of Pigeon Creek located within the refuge boundaries. Pigeon Creek is an intermittent stream which originates approximately 2½ miles north of Crab Orchard Lake. It has two tributaries, Dove Creek and Quail Creek, both of which flow southeastward from the Crab Orchard National Wildlife Refuge wastewater treatment plant and empty into Pigeon Creek approximately ½ mile north of its confluence with Crab Orchard Lake (**Figure 1**).

Methodology

Sample Collection

Five sampling sites were designated along a 1½ mile stretch of Pigeon Creek. One composite sediment sample, comprised of three subsamples, was collected at each sampling location, starting at the confluence of Pigeon Creek and Crab Orchard Lake. Sampling was conducted progressively upstream. **Table 1** describes the sample collection locations.

Sediment samples were collected with either a stainless steel spoon or an Eckman dredge sampler. Subsamples were placed in acetone rinsed stainless steel containers and thoroughly mixed, then placed in 500ml acid-cleaned jars with teflon-lined lids. Sampling equipment was rinsed with acetone between each sample collection location. Sample containers were kept chilled on ice in the field, and then frozen at the field station until shipment to the analytical facilities.

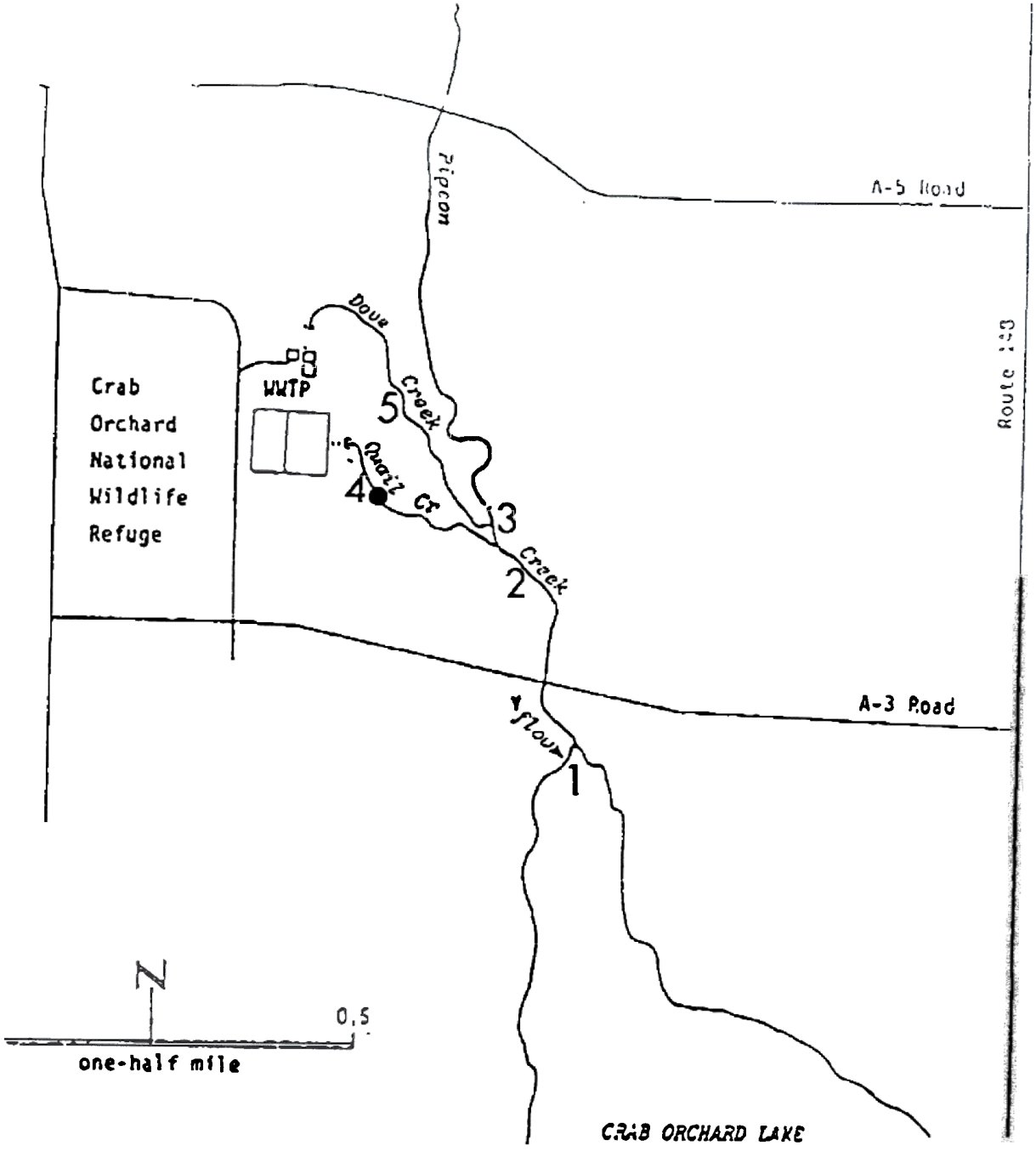

Figure 1. Pigeon Creek study area at Crab Orchard National Wildlife Refuge in 1988.

Table 1. **Pigeon Creek study area sample collection locations at Crab Orchard NWR in 1988.**

Sample Site #	Location
1	Pigeon Creek Bay (1½ miles southeast of the CONWR wastewwater treatment facility at the confluence of Crab Orchard Lake)
2	Pigeon Creek (1 mile southeast of the CONWR wastewater treatment facility)
3	Pigeon Creek/Dove Creek (at the confluence of Pigeon Creek and Dove Creek)
4	Dove Creek (¼ mile southeast of the CONWR wastewater treatment lagoon)
5	Quail Creek (½ mile southeast of the CONWR wastewater treatment facility)

Chemical Analysis

Inorganic and organic analyses were conducted on samples from each site. Chemical residue analysis for organochlorine pesticides and PCBs (total) was performed by Geochemical and Environmental Research Group at Texas A&M University, College Station, Texas. The sediment samples were extracted using the soxhlet extraction method. Freeze-dried samples were homogenized and a small portion of the sample weighed into the extraction apparatus and extracted for 12 hours. The organochlorine fraction was isolated by purification of extracts by silica/aluminum chromatography. Extracts were analyzed by gas chromatography. For the organochlorines the limit of quantification was 0.50 ppm.

Results

The results of the inorganic analyses are shown in Table 2.

The analytical results of the organochlorine pesticide scan for each sample showed concentrations below detection limits for each parameter, and those data are not presented here. The results of the chemical analysis for PCBs are described in Table 3.

The results of the chemical analysis for PCBs (Aroclor 1254) showed levels in sediments ranging from 0.50 to 0.56 ppm (mg/kg). Aroclor 1254 was detected only in sediments from sample site #4. PCBs were not detected in sediments from other sampling locations.

Discussion/Recommendations

Sediment samples from sites #1 through #3, and #5 showed total PCB concentrations at or below the quantification limit (0.50 mg/kg). Sediments from sample site #4, located in Quail Creek, revealed concentrations of 0.56 ppm PCBs (wet weight) in sediments collected approximately ½ mile from the wastewater treatment facility lagoon. This suggests a possible source of PCBs at the wastewater treatment plant.

Two recommendations are made with respect to the present data. First, the sludge piles adjacent to the wastewater treatment facility should be sampled again, and samples submitted for EP/Tox testing. Secondly, if the samples pass the test, the material may be removed and placed in an off-site landfill. This may eliminate potential concerns with respect to PCBs (and metals) originating from the sludge piles and further contaminating Pigeon Creek.

Table 2. **Concentration (mg/kg dry weight) of inorganics detected in sediments collected from Pigeon Creek at Crab Orchard NWR in 1988.**

Sample #	Sample Weight (g)	Percent Moisture	Al	Ag	An	As	Ba	Be	B
1	573.0	36.9	1440	3.96	.266	4.12	104.0	0.47	14.4
2	585.0	33.7	11400	<3.77	.262	5.73	93.5	0.53	19.0
3	489.0	31.5	8940	<3.65	.200	6.39	88.6	0.66	7.66
4	474.0	43.0	13200	<4.39	.275	4.47	113.0	0.44	12.0
5	613.0	30.7	10500	<3.61	.211	7.43	140.0	0.87	11.8

Table 2 (cont.). Concentration (mg/kg dry weight) of inorganics detected in sediments collected from Pigeon Creek at Crab Orchard NWR in 1988.

Sample #	Cd	Cr	Cu	Fe	Hg	Mg	Mn	Mo
1	2.14	19.0	9.59	12200	0.44	1810.0	355.0	<3.96
2	2.11	17.3	8.57	12900	0.60	1440.0	368.0	<3.77
3	0.51	13.8	7.52	12900	0.79	1310.0	661.0	<3.65
4	.67	20.0	9.91	12800	0.98	1620.0	461.0	<4.39
5	<0.36	16.6	9.31	22900	0.81	1390.0	1320.0	<3.61

Table 2 (cont.). Concentration (mg/kg dry weight) of inorganics detected in sediments collected from Pigeon Creek at Crab Orchard NWR in 1988.

Sample #	Ni	Pb	Se	Sb	Sr	Th	Va	Zn
1	12.0	11.2	0.32	<3.96	150.0	0.16	32.8	53.4
2	11.1	11.8	0.45	<3.7	713.4	0.15	30.4	49.
3	9.64	11.9	0.44	<3.6	511.2	0.29	27.0	43.2
4	13.3	15.6	0.53	<4.3	916.8	<0.18	31.6	63.6
5	10.6	11.8	0.87	<3.6	110.6	<0.14	38.5	42.

Table 3. Results of PCB analysis (mg/kg wet weight) for sediment samples collected from five sampling locations along Pigeon Creek in the vicinity of the Crab Orchard wastewater treatment plant in 1988.

Sample Site	Total PCBs
1	
2	
3	
4	
5	